AFCAPS-TR-2016-0001

TECHNICAL REPORT ON CROSS-VALIDATION OF AFOQT FORM S FOR CYBERSPACE OPERATIONS – CYBERSPACE CONTROL

April 20, 2016

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REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. **PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.**

1. REPORT DATE *(DD-MM-YYYY)*
04-20-2016

2. REPORT TYPE
Technical

3. DATES COVERED *(From - To)*
2012-2014

4. TITLE AND SUBTITLE
TECHNICAL REPORT ON CROSS-VALIDATION OF AFOQT FORM S FOR CYBERSPACE OPERATIONS – CYBERSPACE CONTROL

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
Gregory G. Manley, Ph.D.

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Air Force Personnel Center, HQ AFPC/DSYX
550 C Street W
Randolph AFB, TX 78150

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Air Force Personnel Center
Strategic Research and Assessment Branch
Randolph AFB TX 78150

10. SPONSOR/MONITOR'S ACRONYM(S)
HQ AFPC/DSYX

11. SPONSOR/MONITOR'S REPORT NUMBER(S)
AFCAPS-FR-2016-0001

12. DISTRIBUTION / AVAILABILITY STATEMENT
Further distribution only as directed by AFPC/DSYX Strategic Research and Assessment Branch or higher DoD authority

13. SUPPLEMENTARY NOTES

14. ABSTRACT
This study examined the relationship and predictive value of scores from the AFOQT Form S with Final School Grade (FSG) for Air Force Officer Cyberspace Operations / Cyberspace Control School (17D Undergraduate Cyber Training Phase II). Form S scores include officer aptitude composites (*e.g.*, Pilot Composite), individual sub-tests (*e.g.*, Word Knowledge), and Domain (*e.g.*, Conscientiousness) and Facet (*e.g.*, Achievement-Striving) personality scales from the Self-Description Inventory Plus (SDI+). Data from all non-prior service U.S. Air Force Officers who attended the school from November 2010 to March 2012 (N=295) were analyzed and results are reported herein. The sample was separated by quintiles on FSG and results are displayed for each predictor by quintile. The number of attrits was calculated for each quintile, showing a total of only 12, of which 10 fell in the bottom two quintiles and none in the top quintile. All composites and sub-tests were significantly correlated to FSG as were many of the domain and facet scales of the SDI+. A model of the best combination of individual predictors was determined through a series of multiple regression analyses. Recommendations for a best-use selection model and cut-scores are made.

15. SUBJECT TERMS
CYBERSPACE OPERATIONS - CYBERSPACE CONTROL, 17D, Regression modeling, Cross-validation, USAF

16. SECURITY CLASSIFICATION OF: Unclassified			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Kenneth L. Schwartz
U	U	U	U	30	19b. TELEPHONE NUMBER *(include area code)* 210-565-3139

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std. Z39.18

TECHNICAL REPORT ON CROSS-VALIDATION OF AFOQT FORM S FOR CYBERSPACE OPERATIONS – CYBERSPACE CONTROL

(AFSC-AWARDING 17D PHASE II FINAL SCHOOL GRADE)

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JUNE 2014

SUMMARY

This study examined the relationship and predictive value of scores from the Air Force Officer Qualifying Test (AFOQT) Form S with Final School Grade (FSG) for Air Force Officer Cyberspace Operations / Cyberspace Control School (17D Undergraduate Cyber Training Phase II). Form S scores include officer aptitude composites (*e.g.*, Pilot Composite), individual sub-tests (*e.g.*, Word Knowledge), and Domain (*e.g.*, Conscientiousness) and Facet (*e.g.*, Achievement-Striving) personality scales from the Self Description Inventory Plus (SDI+). Data from all non-prior service U.S. Air Force Officers who attended the school from November 2010 to March 2012 (N=295) were analyzed and results are reported herein. The sample was separated by quintiles on FSG and results are displayed for each predictor by quintile. The number of attrits was calculated for each quintile, showing a total of only 12, of which 10 fell in the bottom two quintiles and none in the top quintile. All composites and sub-tests were significantly correlated to FSG as were many of the domain and facet scales of the SDI+. A model of the best combination of individual predictors was determined through a series of multiple regression analyses. This model was cross-validate with subsequent samples and revised. Recommendations for a best-use selection model and cut-scores are made.

PREDICTIVE VALIDATION OF AFOQT FORM S FOR CYBERSPACE OPERATIONS – CYBERSPACE CONTROL (AFSC-AWARDING 17D PHASE II FINAL SCHOOL GRADE)

The 17D Air Force Specialty (AFS) Phase II School is the AFS-awarding school for officer Undergraduate Cyber Training (UCT). In this AFS, officers are trained to execute the functions and activities of cyberspace and information operations. In the field they plan, organize, and direct operations; including network attack, network defense, network warfare support, network operations, and related information operations. Such operations cover the spectrum of mission areas within the domain of cyberspace. 17D UCT encompasses two primary curricula, *Cyber Defense* and *Cyber Control*. The former includes activities such as planning, organizing, and performing network defense; and exploitation and attack in support of mission objectives. The latter involves the planning, organization, and performance of network operations to include establishment, operations, and information assurance and defense in support of mission objectives. At the time these Final School Grades (FSGs) were observed, the training encompassed both curricula, however, specialty shred-outs have since been designated for the Cyber Defense (17DXA) and Cyber Control (17DXB) Air Force Specialty Codes (AFSCs).

Currently, there is no formal test for selecting officers for training in 17D UCT nor are there any cut-scores in use on any AFOQT composite other than those for becoming an Air Force officer. Selection into the 17D AFS is conducted through a computer program that examines the candidates' required undergraduate coursework. A Bachelor of Science in an appropriate undergraduate major for 17D UCT are considered (*e.g.*, Computer Science, Information Technology) as are other Bachelor of Science majors if the candidate has accomplished at least 24 credit hours of appropriate sciences courses (*e.g.*, Telecommunications, Engineering, Information Assurance). This study was conducted to determine if any test scores available from Form S of the AFOQT were predictive of 17D UCT performance and course completion; and to develop a predictor model with cut-score recommendations.

METHOD

Initial Validation Sample

Data included 295 usable cases of all non-prior service (NPS; directly accessing from college) U.S. Air Force officers attending the school between the dates of November, 2010 (inception of UCT) and March, 2012. Any senior U.S. Air Force officers and other non-U.S. Air Force officer cases were removed including foreign nationals, civilians, enlisted Air Force and other U.S. Services personnel. Of the 295 NPS U.S. Air Force officer cases, Phase II attrition was low, around 4% as only 12 did not fully complete the course. Most attrition appears to be related (in part at least) to academic performance, with 8 falling in the bottom quintile based on FSG and 0 in the top. Note that 17D UCT Phase I is a qualifying course for Phase II where some initial attrition occurred (5 of 300 NPS Air Force officer students or 1.7%). Overall combined attrition for both Phase I and II was 5.7%.

Re- and Cross-validation samples

An additional 291 17D students were added to the sample who attended the training from April 2012 to January 2014. The subsequent sample (N=291) was used for initial cross-validation. For further re-validation and cross-validation purposes, the full sample (N=586) was randomly assigned to two groups (re-validation and cross-validation samples) using a bi-fold design.

The total sample was mostly male (81%), ethnically non-Hispanic (89.5%) and White (72%). Other races reported included Asian (14%), Black or African-American (9.8%), Native American or Alaskan (2.7%), and Pacific Islander (1.4%).

Measures of the AFOQT – Form S

Side 1 of the AFOQT Form S contains various subtest measures of general and specific cognitive abilities from which composite scores are computed. These include *Verbal Analogies* (VA), *Arithmetic Reasoning* (AR), *Word Knowledge* (WK), *Math Knowledge* (MK), *Instrument Comprehension* (IC), *Block Counting* (BC), *Table Reading* (TR), *Aviation Information* (AI), *General Science* (GS), *Rotated Blocks* (RB), and *Hidden Figures* (HF). The composites are used for selection into rated officership (i.e., pilots) and as minimums for becoming an Air Force officer. The composites are labeled *PILOT*, *NAVIGATOR-TECHNICIAN*, *ACADEMIC*, *VERBAL*, and *QUANTITATIVE*. Thompson, Skinner, Gould, Alley, & Shore (2010) provided a full description of the subtest and the computed composites. Reliabilities for the subtests are typically acceptable to good in the normative sample (αs ranging between .71 and .90) and are reported in Morath, Parish, and Lodato (2010). Parish, Morath, Lodato, and Stachowski (2010) conducted test-retest reliability analyses for the composites from a sample of Air Force applicants who took the same forms twice and found them to be moderately high, with coefficients ranging between .82 and .89.

Side 2 of Form S contains self-report personality trait items of the Self Description Inventory Plus (SDI+), an inventory designed to measure the factors of the Big Five as well as Teamwork Orientation and Service-Before-Self Orientation (Tupes & Christal, 1961; Thompson et al., 2010). Manley (2011) conducted a factor analyses based on roughly 60,000 U.S. Air Force applicants to develop Domain- (broad) and Facet- (narrow) level scales for the SDI+. The Domain scales include the Big Five (*Agreeableness*, *Neuroticism*, *Introversion-Extraversion*, *Conscientiousness*, & *Openness*) and a smaller sixth factor called *Machiavellianism* (Mach). The Facet scales were also factorially derived by separately factor analyzing the Domain factors producing 20 facets in total. These Domains and Facets are listed in Tables 4 – 9. Reliabilities for theses scales are generally acceptable to very good for the normative sample, ranging in the .70s to high .90s for most scales, and are reported in Manley (2011).

Procedure

The AFOQT Form S predictor data and the 17D UCT school FSG data were submitted to descriptive statistical and correlational analysis to compute means (Ms), standard deviations (SDs), and a correlation matrix for the study variables. A distribution histogram of FSG (overall percent correct) was plotted and is shown in Figure 1. The FSG data appears mostly normally distributed with a negative skew to the lower end of the distribution due to range restriction as most scores are distributed about the upper range of possible scores. Quintiles on the FSG variable were determined so that the *n*-size for each group was roughly equal (the quintile cut points used produced the most evenly numbered groups possible). Figure 1 graphically displays the quintile breakdown among the distribution of FSG scores. Table 1 reports the *n*-sizes, range of scores, and descriptive statistics (Ms, SDs) for the quintiles.

Using multiple regression analysis, FSG scores were regressed on different combinations of significant predictors (zero-order correlations $p < .05$) to determine the best model in terms of variance predicted, parsimony, and unique contribution of each variable to predicting FSG variance.

Possible cut-scores were examined for optimal prediction with minimal decision errors (Type I or Type II) by applying the recommended weights from the optimal predictor model to scores from the sample. Chi Square analysis was used to determine hit and miss rates of the model predicting FSG above or below a FSG score of 80 (FSG=80 was used as a conservative base rate of "success" because the model was developed on the same sample and most students in the sample passed the course) and Phi coefficients (ϕ) were examined to determine the best fitting model cut-score. Standardized mean score differences (Cohen's *d*) for EEOC protected subgroups were examined.

RESULTS

The Ms, SDs, and criterion-related validities (r_{xy}) for each predictor that were observed from the correlation matrix are reported in Tables 2 – 9. The Ms for each predictor by FSG quintile are also reported in Tables 2 – 9 and graphically displayed in Figures 2 – 9.

Composites

All AFOQT composites had significant uncorrected criterion-related validities with FSG ($p<.001$). The uncorrected validities (*r*s) ranged from .29 (QUANTITATIVE) to .38 (ACADEMIC) and averaged .35. Table 2 reports these validities and the mean composite percentile scores for each quintile. Both Table 2 and Figure 2 display the mean composite scores by quintile as monotonically increasing. The average score for the first (bottom) to the fifth (top) quintiles are respectively, 50, 61, 64, 67, and 80. These validity and mean quintile results indicate all composites are highly valid, positive linear predictors of overall 17D UCT academic performance.

Sub-Tests

As was the case with the composites, all AFOQT sub-tests had significant uncorrected criterion-related validities with FSG ($p < .001$ or $p < .01$). The validities ranged from .19 (BC, TR) to .34 (WK, GS) and averaged .26. Table 3 reports these results and the mean scores by quintiles are displayed in Table 3 and Figure 3. Again, the quintile scores are monotonically increasing for all predictors, which along with the significant validities, indicate the sub-tests are valid (highly valid in some cases), positive linear predictors of overall 17D UCT academic performance.

SDI Domains

Table 4 reports the uncorrected criterion-related validities for the Domain personality scales with FSG. Non-cognitive scales are not expected to be as highly predictive of performance in a cognitive domain (academic performance) but are hoped to predict some unique variance of school performance (or attrition) due to non-cognitive personal characteristics (*e.g.*, stress tolerance, teamwork orientation, or motivation). Here, three of the six scales were significantly correlated with FSG. Neuroticism ($r = -.21$, $p < .001$) and Conscientiousness ($r = .19$, $p < .001$) were the two best Domain predictors with Agreeableness also significantly predicting FSG ($r = .12$, $p < .05$). From an examination of Table 4 and Figure 4, the Domain scale means by quintile are monotonic (increasing or decreasing in the expected direction) for the significant predictor domains, indicating a valid linear relationship with FSG. However, two of the non-significant domains appear to show a nonlinear relationship with FSG, which would result in poor validity when scaled as linear. Introversion-Extraversion (high scores indicate Introversion) shows lower scores for bottom and top FSG quintiles and Openness shows higher scores for bottom and top quintiles.

The graphs suggest that these two scales may be predictive if modeled in an appropriate nonlinear way. Individual follow-up regression analyses modeling these variables as quadratic (as shown below), however, showed no significant prediction.

$$\text{FSG} = b_0 + b_1\text{X} + b_2\text{X}^2 \ldots + \mathcal{E}$$

Where X is the predictor test and b_0, b_1, and b_2 are the weights for the intercept, linear, and quadratic terms, respectively. A cubed term ($b_3\text{X}^3$) is added to the equation for a cubic polynomial regression. The $\mathcal{E}$ term represents normally distributed random error.

SDI Facets

The SDI domains each have a number of sub-factors called facets associated with them. The number of facets per domain vary, ranging from two (Conscientiousness) to five (Agreeableness), and total 20 facets for all six domains. Eight of these facets had significant uncorrected criterion-related validities with FSG.

The *Agreeableness* domain has five facets, two of which had significant validities with FSG, *Team Player* (A1; r=.19, p<.001) and *Hyper-Competitive* (A5; r=-.12, p<.05). Table 5 reports the results for the Agreeableness facets. As shown, the facets of *Pleasant* (A2), *Considerate* (A3), and *Helpful-Altruistic* (A4) did not significantly correlate to FSG, however, Pleasant was nearly as predictive (r=.11) as Hyper-Competitive. Figure 5 displays graphically the relationship between the facets and FSG quintile. As shown, the facet of Hyper-Competitive appears to have somewhat of a non-linear relationship with FSG in that the relatively higher scores tend to be grouped in the middle quintiles (especially the second quintile) while the lowest scores tend to appear in the highest (fifth) quintile. Predictability of FSG for this facet may be improved by appropriately modeling both linear and non-linear relationships with the criterion. As was the case with the Introversion-Extraversion and Openness domain scales though, quadratic (or polynomial) regressions were non-significant.

Neuroticism has three facets, *Stress-Under-Pressure* (N1; r=-.22, p<.001), *Temperamental* (N2; r=-.17, p<.01), and *Worry* (N3; r=-.13, p<.05), and all had significant validities with FSG. Table 6 and Figure 6 display these results. The quintiles bar graph indicates a generally linear relationship of these facets with FSG. Note the Stress-Under-Pressure facet has essentially the same validity as the Neuroticism domain scale (r=-.21), indicating that this facet is the primary driver of the domain scale in predicting FSG.

Table 7 reports the validities for the three *Introversion-Extraversion* facets. Note that while high scores on the IE domain scale indicate Introversion, high scores on *Dominance* and *Sociability* facet scales indicate Extraversion. Of the IE facet scales, only the *Dominance* (IE3) facet was significantly related to FSG (r=.13, p<.05). The facets of *Unassertive* (IE1) and *Sociable* (IE2) did not significantly predict the criterion; however, an examination of Figure 7 shows the *Sociable* facet to be somewhat nonlinear in its relationship with FSG in that those scoring relatively higher on this scale are either in the top or bottom quintiles while those scoring relatively lower reside in the middle quintiles. This graph suggests it is possible that this measure is significantly predictive of FSG when scaled in an appropriate nonlinear way. Again, FSG was regressed on the linear and quadratic terms for the *Sociable* scale and resulted in a significant prediction model (R=.19) with all terms statistically significant (intercept, linear, and quadratic terms; p < .005). This result is interpreted as those lower in Sociability generally tend to do better than mid-level Sociability, but those very high in Sociability also do well. Table 7 shows this scale was a non-significant linear predictor of FSG with an observe effect size of r = -.03, hence non-linear scaling of this variable greatly improves its predictability.

Results for the two *Conscientiousness* facets are reported in Table 8. *Achievement-Striving* (C1) significantly predicted FSG (r=.21, p<.001) and while *Order* (C2) was non-significant, a small effect was observed nonetheless (r=.10). Figure 8 clearly indicates a very linear pattern for Achievement-Striving and a generally linear pattern for Order predicting FSG.

Openness has four facets, of which only *Creative* (O1) significantly predicted FSG (r=.16, p<.01), as reported in Table 9. Of note, this facet has a significant effect size while the Openness domain was non-significant (r=.05), which speaks to the importance of developing and operationally using narrower facet scales as opposed to broader domain scales when predicting occupational-specific criteria. The remaining facets of *Reflective* (O2), *Scientific Interest* (O3), and *Cultured* (O4) were non-significant predictors but the latter two had small but noticeable effects sizes that were close in magnitude to some of the significant facet predictors (rs=.10). An examination of Figure 9 indicates positive liner relationships with FSG for both Creative and Scientific Interest, however, as in the case with Sociability, the facets of Reflective and Cultured show possible nonlinear relationships with the criterion. The former showing relatively higher scores for the top and bottom quintiles and the latter a possible multiple bend curve. Modeling Cultured in a polynomial (or quadratic) regression did not result in a significant model; however, modeling Reflective as a quadratic resulted in a significant predictor model with all terms significant (p<.05) and an effect size of R = .14, an improvement over the r = -.06 linear correlation.

The last domain of *Machiavellianism* constitutes the three facets of *Envious* (M1), *Individualistic* (M2), and *Self-Serving* (M3). These scales are shorter than most of the other facet scales (3 to 4 items each) and have marginal reliabilities (αs range from .56 to .77). As shown in Table 10, none of these facets were significant predictors of FSG. Figure 10 displays the FSG quintile results for the facets and reveal no obvious non-linear (or linear) pattern of relationship.

Regression Modeling

All the cognitive (composites, subtests) and many of the non-cognitive (domains, facets) scales of the AFOQT Form S appear to be quite predictive of 17D UCT Phase II FSG. Additionally, the significant non-cognitive predictors likely predict variance of FSG that is largely unique to that predicted by the cognitive measures. Simply choosing one predictor would be effective, but would not allow for the unique contribution of other predictors. Many of these predictors likely covary and including all of them would be redundant and unnecessary. However, some may uniquely contribute to the overall possible predicted variance. Thus, an optimal combination of some number of significant unique predictors is desired for maximizing predictive ability.

A series of multiple regression analyses began with entering all predictors with significant-zero order correlations at the individual scale level (see Tabachnick & Fidell, 2001, p.133, for an explanation on best-practice procedures for the model building process using multiple regression, *i.e.*, variable inclusion/exclusion). While some facet scores showed promise with nonlinear scaling [*i.e.*, Sociability (IE2) & Reflective (O2)], model building began with linear predictors that showed significant zero-order correlations. Individual test scores (subtests & facets) were exclusively used to avoid overlap of item content among variables from different levels (*e.g.*, same items appearing in composite and subtest). This resulted in a 19 variable model predicting 25% of the FSG variance. This model is useful but overly complex and quite redundant as evidenced when most of the predictors non-significantly, uniquely contribute to prediction of FSG. In fact only MK, GS, and C1 were significant (p<.05) in this linear combination. However, predictors that are non-significant should not necessarily be excluded because they may be significant in other combinations. Therefore, any predictor that was significant at p<.20 was then included in the next multiple regression.

The next model included seven predictor scores (MK, GS, C1, WK, IC, IE3, and O1) and predicted 23% of the FSG variance. This resulted in only a slight reduction in prediction while drastically reducing the complexity of the model. As was the case in the first model examined, some of the predictors covary with one another as evidenced by three of the seven being non-significant (MK, IE3, & O1). Retaining the significant predictors (p<.05) for the next multiple regression, the third model included WK, IC, GS, and C1. This model predicted almost as well, 22% of the variance with all four predictors significant (p<.05). Lastly, those facet scales that showed significant quadratic terms predicting FSG (O2 & IE2) were included in this model. O2 and its squared term were not significant predictors in the model, however, both IE2 and its squared term were.

The model shown below is summarized in Table 11 and, prior to cross-validation on an independent sample, was the recommended model for 17D UCT academic performance and formulates the *Cyber Composite Score.* This model had a multiple correlation of R = .48 and predicted 23% of the variance with all predictors statistically significant (p<.05). The parameter estimates (b) and standardized beta weights (β) are reported in Table 11.

Validated Initial Cyber Composite Score [1] $= b_0 + b_1\text{WK} + b_2\text{GS} + b_3\text{IC} + b_4\text{C1} - b_5\text{IE2} + b_6\text{IE2}^2 + \varepsilon$

Cross-validation (using weights from development (random half) sample, Bi-fold design.

Once subsequent data became available for cross-validating the Cyber Composite Score (N=291), the validated cyber composite score was cross-validated to assess prediction independent of data used in initial model building (sans Type II error due to chance statistical relationships). The IE2 terms (linear and quadratic terms for Sociability) were not significant contributors upon cross validation (p>.05).

Cross validation of initial cyber composite model:
```
C17DXQ = 70.77+.24*WK+.37*GS+.17*IC+.0013*C1-.0015*IE2+.000000194*IE2sq;
```
R = .396 (n = 291 CV sample).

Once the initial cyber composite score was cross-validated to produce the reduced model without the IE terms, all data were combined (initial validation and subsequent data; N=586) and then randomly assigned to two groups, a subsequent validation group (to replicate the model building process of the first cross-validation process) and a cross-validation sample to further assess prediction independent of data used in model building in a bi-fold design. This design validates the reduced model with one sample and cross-validates the model with the other, then reverses the process. So both samples are used to

[1] *Note*. WK = Word Knowledge, GS = General Science, IC = Instrument Comprehension, C1 = Achievement-Striving, IE2 = Sociability, Ɛ = normally distributed random error term.

validate and cross-validate the model separately for replicability of results. Below are the regression models for the bi-fold cross-validation process.

Bi-fold cross-validation:
Bi-fold 1:
`C17DXL2 = 71+.20*WK+.26*GS+.17*IC+.0013*C1`
R = .405 (n = 283 DEV sample 2, MYLIB.OQT17DB2). All linear terms significant (p<.05).
R = .431 (n = 303 CV sample 1, MYLIB.OQT17DB).
+ΔR = .026

Bi-fold 2:
`C17DXL2b = 68.25+.30*WK+.41*GS+.09*IC+.0013*C1`
R = .444 (n = 303 DEV sample 1, MYLIB.OQT17DB). All linear terms significant (p<.05) except IC.
R = .396 (n = 283 CV sample 2, MYLIB.OQT17DB2).
-ΔR = .048

Average shrinkage, -ΔR = .022

Final model weights based on full sample

The final cross-validated model shown below is summarized in Table 12 and is the recommended model for 17D UCT academic performance and formulates the *Cyber Composite Score.* This model had an average observed multiple correlation of *R* = .423 average cross-validity of R = 4.01 before any correction for range restriction.

$$\textbf{\textit{Final [Cross-Validated] Cyber Composite Score}} = b_0 + b_1\mathbf{WK} + b_2\mathbf{GS} + b_3\mathbf{IC} + b_4\mathbf{C1} + \mathcal{E}$$

Recommended linear model with full sample weights applied:

`Final CSS = C17DXL = 69.6+.25*WK+.33*GS+.13*IC+.0013*C1`

Cut-Score Recommendations

In an attempt to discern an optimal cut-score for the Cyber Composite Score (CCS), the expected values of FSG (which is the CCS) are plotted against the actual FSG values (Figure 11). An FSG of 70 (on the y-axis) is considered passing. Note only those who made it all the way through the course are represented in this sample (although not all passed with 70 or above). Corrections for range restriction are necessary for accurate estimates of cross-validity due attenuation in observed validities.

Plotting the CCS against FSG enables a visual examination of the effect of imposing various cut-scores in terms of prediction model hits and misses. Several likely cut-scores were examined: CCS = 80, 81, 82, 83, 84, 85, and 86. Hits and misses are evaluated in terms of Correct Accepts (α power), Correct Rejects (β power), Incorrect Accepts (Type I error), and Incorrect Rejects (Type II error). Chi Square analyses (and Fisher's Exact tests) were conducted for the seven cut-scores that were determined from the visual examination of the scatter plot (see Table 13).

Table 13 summarizes the results of the Chi Square tests for the various cut-scores of 80 through 86. The Chi Square value (χ^2), the Phi Coefficient (ϕ), Total Power ($\alpha + \beta$), and Total Error (Type I + Type II) are reported as indicators in side-by-side comparisons of the cut scores. As shown, a cut-score of 80 is preferred overall and for each indicator. The Chi Square statistic, the Phi Coefficient, and Total Power are largest and Total Error is smallest for this cut-score. Thus, a cut-score of CCS=80 is recommended for most efficiently increasing accession pool. An alternative cut-score of 83 is recommended if reducing school attrition is the primary goal. Tables 14a and 14b reports the details of Chi Square analysis for these two cut-scores.

Subgroup Mean Score Differences

In the interest of diversity and fairness, average levels of CCS were computed in a random sample of AFOQT scores and compared across EEOC protected subgroups that appeared in sufficient numbers for statistical analysis (i.e., $n > 90$). The comparisons of interest are sex, ethnicity (Hispanic), and Race. Of the groups with sufficient sample size, sex, ethnicity (non-Hispanic to Hispanic), race (White-Black & White-Asian) were compared. Specifically the standardized mean CCS difference was examined for effect size (Cohen's *d*) and statistical significance (95% Confidence Interval not containing a value of 0). This type of analysis indicates if there is a significant difference ($p<.05$) in the average predictor score between two groups of comparison and the magnitude of that differences, expressed in standard deviation units (*d*).

Table 15 reports the results of this set of analyses. All of the four comparisons show a statistically significantly higher mean score for the majority group of comparison and each varied as to the effect size. Male to Female comparison showed a significant difference with an effect size of d=.67 favoring males, which according to Cohen's (1977) arbitrary heuristic, is considered a moderate difference. This is not unlike Male-Female differences in cognitive abilities tests of this nature and is similar to other studies involving the AFOQT Form S (*e.g.*, Hardison, Sims, & Wong, 2010). Non-Hispanic to Hispanic comparison resulted in a *d*-value of .17, which was significant but the lower bound of the 95% Confidence Interval was nearly zero (.01). Note that the minority group in this comparison (Hispanic) includes Whites and males, whereas the majority group in the Male to Female comparison included Hispanics and non-Whites. Only two minority groups where large enough for statistical analysis of racial comparisons. Here Whites comprise the majority group. The White-Black comparison showed a significant *d*-value of 1.04 favoring Whites, which is considered a large effect by Cohen's standard. Finally the White-Asian comparison showed a *d*-value of .34, which Cohen considers a small sized effect. These racial differences are also typical in effect size to other studies of the AFOQT Form S (*e.g.*, Hardison et al., 2010).

DISCUSSION

Summary of Findings

Cognitive and non-cognitive variables of the AFOQT-S were examined in their potential to predict school outcomes for 17D UCT Cyber Defense and Cyber Control Officer. All cognitive subtests and eight of 20 non-cognitive facet variables showed statistically significant zero-order correlations with school outcomes. A series of regression analyses with decision rules in line with best practices for selection and classification guided the model building process (Tabachnick & Fidell, 2001), which resulted in a recommended 17D Composite for predicting school performance. Cut-score analyses determined two optimal cut-scores for maximizing on classification efficiency, which depend on current needs of the Air Force.

Unique Contributions to the Predictor Space

The recommended model includes constructs that do not theoretically or empirically overlap in the predictor space of the 17D School outcome. Included in the model are linear predictors, i.e., WK (verbal, cognitive domain), GS (science, cognitive domain), IC (perceptual, cognitive domain), and C1 (achievement motivation, non-cognitive domain). This relatively simple model predicts nearly as well as the more complex configurations explored in the model building process. This cross-validated model should be more stable as it capitalizes less on chance relationships of the predictor variables with the criterion.

It is also interesting to note that math, science, and technology majors and curricula are currently targeted as selection requirements for cyber training, however tests of verbal ability (WK & VA) were also strong predictors of school performance. Table 3 shows WK and VA (along with GS) to have the three highest zero-order correlations with FSG among the cognitive subtests of the AFOQT. Although this may in part be due to indirect range restriction on quantitatively-oriented coursework as the current selection method (which can artificially attenuate observed validities of math and science predictors), it speaks to the importance of verbal ability in cyber training success. This finding has potentially important implication for classification as applicants with math degrees (which presumably are high in demand) may better serve the Air Force in other AFSs while cyber training may be better staffed by those high in verbal ability.

Summary of Recommendations

Currently there is a classification system that evaluates if the candidate has the required coursework or has a qualified undergraduate major. This system seems to be working well as overall attrition for Phases I and II combined is around 6%; however, it is only an indicator of classes taken, not the quality of performance in those classes.

The CCS is recommended to be used in two possible ways: First, as a counseling tool to advise those as to their probability of success in Undergraduate Cyberspace Training. This could be conducted at the accession source at the time of job selection, typically Junior year of college (at least for AFROTC and USAFA).

Second, as a tool for the Officer Accessions Branch (DPSIP) to use in addition to the existing classification system. With the CCS, the classification officer can stack rank among qualified candidates those with the highest probability of success in training. This is quite appropriate because the model was developed from those who have met the classification qualification. In other words, the model was developed from a sample of airmen who already had the minimum required coursework on their college transcripts. As the model becomes more fully validated on subsequent samples, it could eventually replace the current classification system.

Limitations and Conclusion

The observed validities of the predictors in the CCS and correlation matrix have not been adjusted for direct range restriction of the sample that was selected for officership into the U.S. Air Force or indirect restriction in range resulting from the current classification system that selected the officers into training for Air Force Officer Cyberspace Operations / Cyberspace Control School. As such, the observed correlations are artificially suppressed and are likely larger effects than shown.

REFERENCES

Cohen, J. (1977). *Statistical power analysis for behavioral sciences* (Revised Ed.). New York: Academic Press.

Hardison, C. M., Sims, C. S., & Wong, E. C. (2010). *The Air Force Officer Qualifying Test: Validity, fairness, and bias*. Santa Monica, Calif.: RAND Corporation, TR-744-AF. As of August, 2012: http://www.rand.org/pubs/technical_reports/TR744/

Manley, G.G. (2011). *Development of domain and facet level scales for the Self Description Inventory*. AFACPS-TR-2011-0007. Randolph AFB, TX: HQ AFPC/DSYX Strategic Research and Assessment Branch.

Morath, R., Parish, C., and Lodato, M. (2010). *AFOQT Form S effectiveness analysis: Subtest level analyses and report*. AFCAPS-FR-2010-0011a, ADB360254. Randolph AFB, TX: HQ AFPC/DSYX Strategic Research and Assessment Branch.

Parish, C., Morath, R., Lodato, M., and Stachowski, A. (2010). *AFOQT Form S effectiveness analysis: Composite level analyses and report*. AFCAPS-FR-2010-0011b, ADB360697. Randolph AFB, TX: HQ AFPC/DSYX Strategic Research and Assessment Branch.

Thompson, N., Skinner, J., Gould, R. B., Alley, W., & Shore, W. (2010). *Development of the Air Force Officer Qualifying Test (AFOQT) Form R and the implementation of Form S.* AFCAPS-FR-2010-0003, ADB358824. Randolph AFB, TX: HQ AFPC/DSYX Strategic Research and Assessment Branch.

Tupes, E. C., & Christal, R. E. (1961). *Recurrent personality factors based on trait ratings*. ASD-TR-61-97. Personnel Laboratory Aeronautical Systems Division Air Force Systems Command.

Tabachnick, B.G., & Fidell, L.S. (2001). *Using multivariate statistics (4th)*. Needham Heights, MA: Allyn and Bacon.

Table 1.
17D AFS-Awarding Final School Grade Quintiles

	Total	quintile1	quintile2	quintile3	quintile4	quintile5
N	295	53	72	75	54	41
Range	1 to 99	51-81	82-85	86-88	89-91	92-98
M	85.9	76.7	83.7	87.1	90	94
SD	6.4	7.8	1.1	0.8	0.9	1.5

Figure 1.
Distribution of 17D AFS-Awarding Final School Grade Quintiles (N=295).

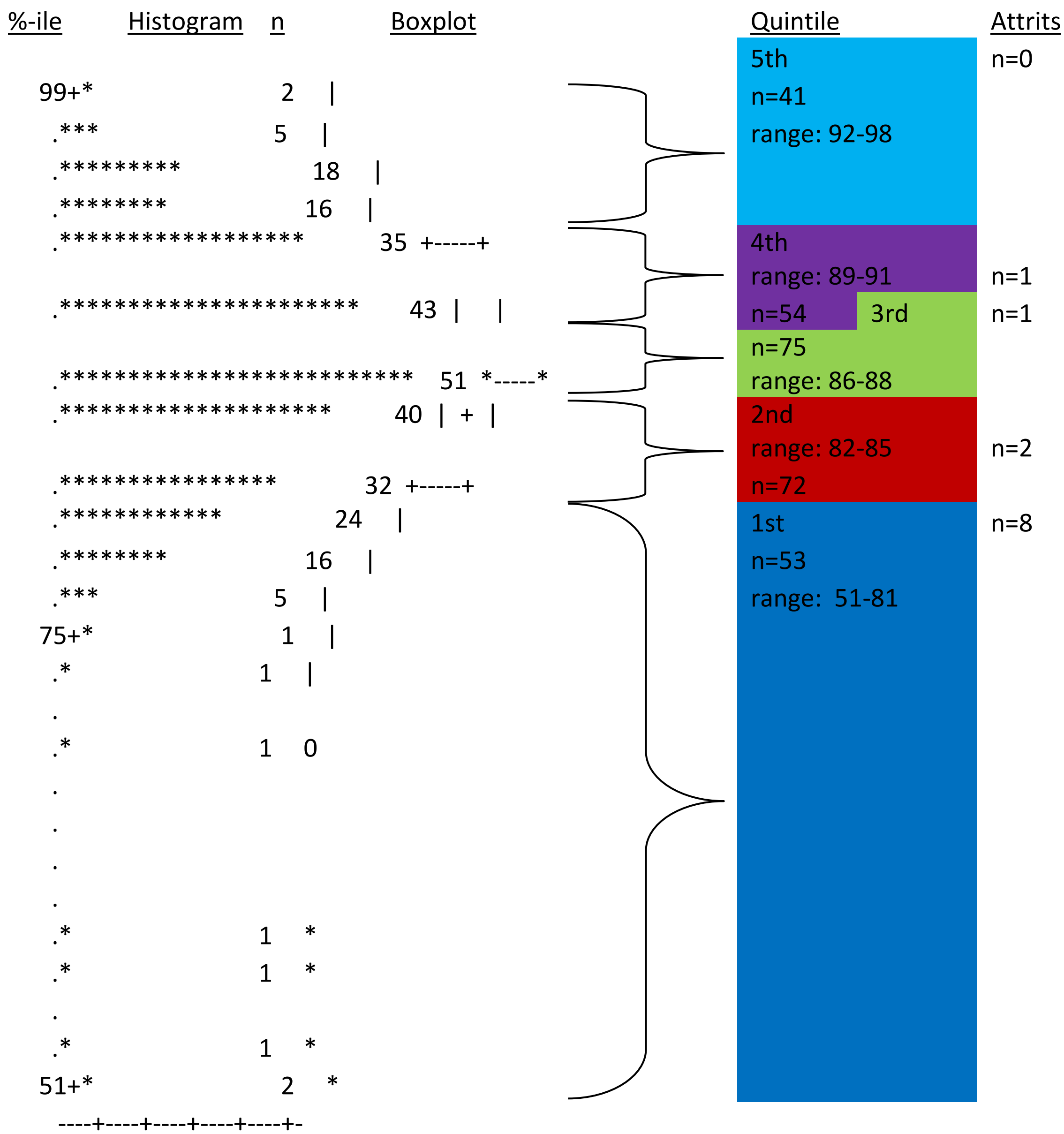
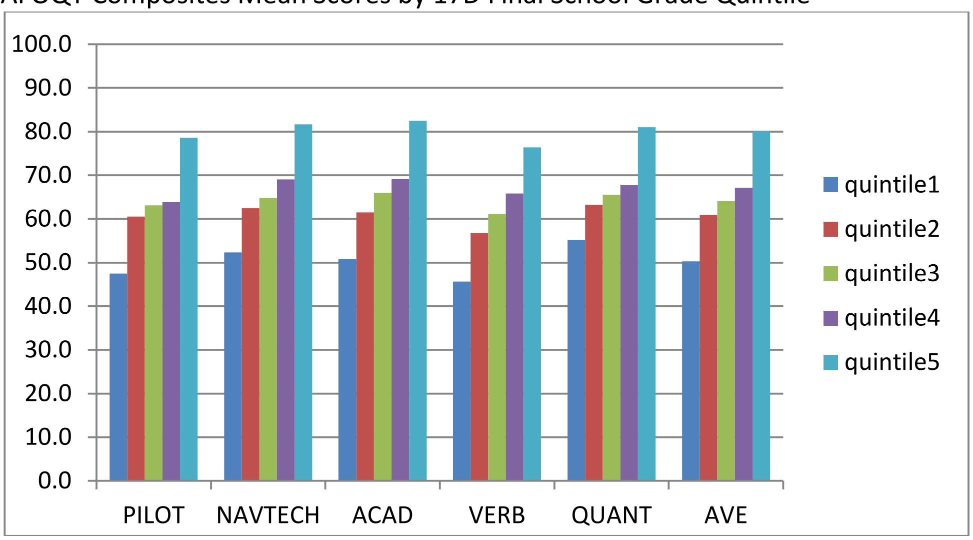


Table 2.
AFOQT Composites Mean Scores by 17D Final School Grade Quintile

Composite	M	SD	r_{xy}	quintile1	quintile2	quintile3	quintile4	quintile5
PILOT	62.0	24.7	.36***	47.5	60.5	63.1	63.9	78.6
NAVTECH	65.1	25.0	.35***	52.3	62.4	64.8	69.1	81.7
ACAD	65.0	25.0	.38***	50.8	61.5	66.0	69.1	82.5
VERB	60.3	26.1	.36***	45.6	56.7	61.1	65.8	76.4
QUANT	65.7	24.9	.29***	55.2	63.3	65.5	67.7	81.0

Notes. *** $p < .001$, r_{xy} is the uncorrected correlation with final school grade. Scores are percentiles.

Figure 2.
AFOQT Composites Mean Scores by 17D Final School Grade Quintile



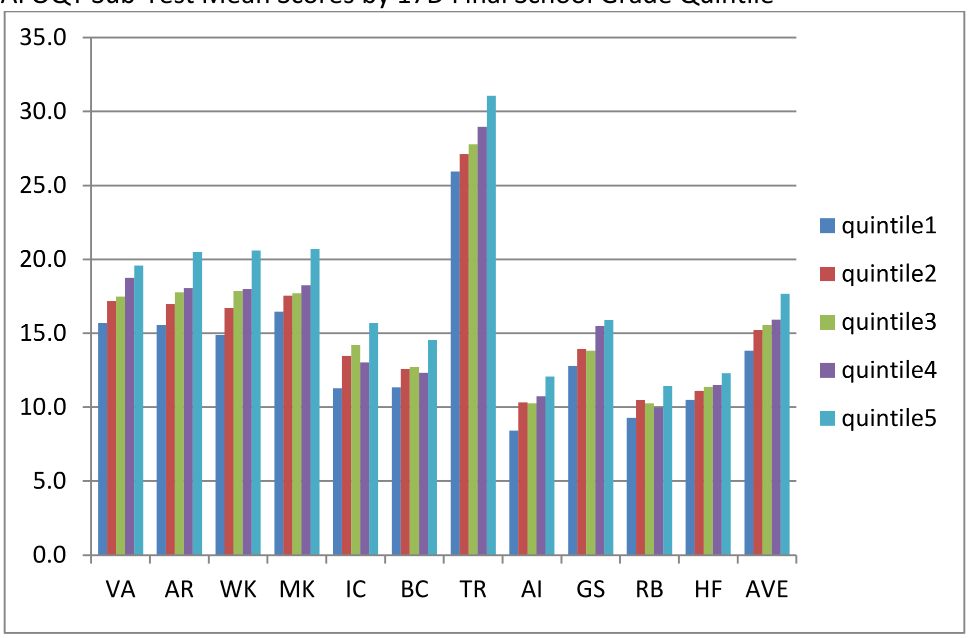
Note. Percentile scoring on y-axis.

Table 3.
AFOQT Sub-Test Mean Scores by 17D Final School Grade Quintile

Sub-Test	M	SD	r_{xy}	quintile1	quintile2	quintile3	quintile4	quintile5
Verbal Analogies (VA)	17.6	3.7	.33***	15.7	17.2	17.5	18.8	19.6
Arithmetic Reasoning (AR)	17.6	5.0	.28***	15.6	17.0	17.8	18.1	20.5
Word Knowledge (WK)	17.5	5.0	.34***	14.9	16.7	17.9	18.0	20.6
Math Knowledge (MK)	18.0	4.7	.25***	16.5	17.5	17.7	18.2	20.7
Instrument Comprehension (IC)	13.5	4.8	.25***	11.3	13.5	14.2	13.0	15.7
Block Counting (BC)	12.6	4.1	.19**	11.3	12.6	12.7	12.3	14.5
Table Reading (TR)	28.0	7.1	.19**	25.9	27.1	27.8	29.0	31.1
Aviation Information (AI)	10.3	3.6	.28***	8.4	10.3	10.3	10.7	12.1
General Science (GS)	14.3	3.3	.34***	12.8	13.9	13.8	15.5	15.9
Rotated Blocks (RB)	10.2	3.1	.21***	9.3	10.5	10.3	10.0	11.4
Hidden Figures (HF)	11.3	3.2	.21***	10.5	11.1	11.4	11.5	12.3

Notes. *** $p < .001$, ** $p < .01$, r_{xy} is the uncorrected correlation with final school grade. Scores are number correct (totals vary by subtest).

Figure 3.
AFOQT Sub-Test Mean Scores by 17D Final School Grade Quintile



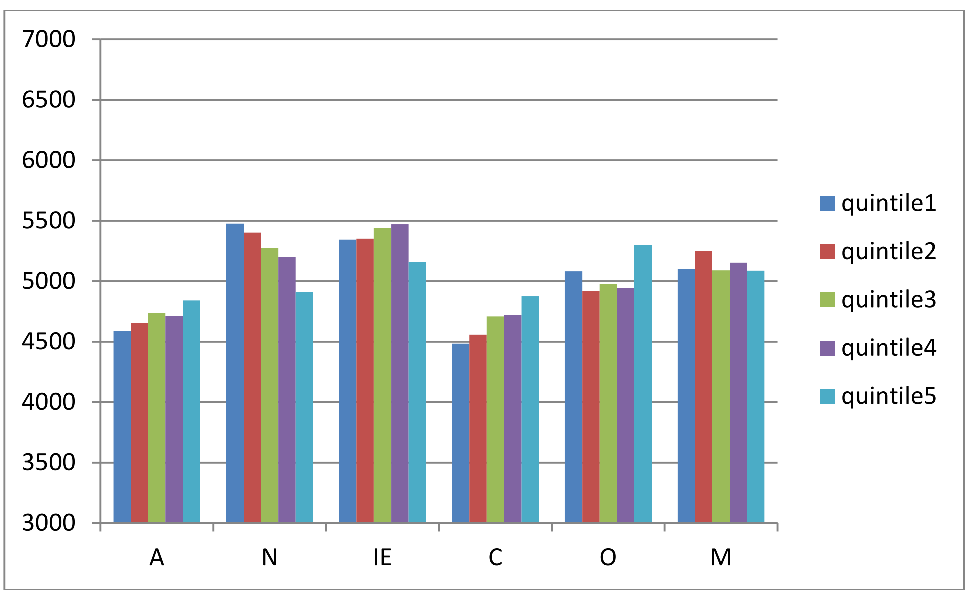
Note. Number correct on the y-axis (totals vary by subtest).

Table 4.
SDI+ Domain Mean Scores by 17D Final School Grade Quintile

Domain	M	SD	r_{xy}	quintile1	quintile2	quintile3	quintile4	quintile5
Agreeableness (A)	4700	990	.12*	4588	4653	4738	4713	4842
Neuroticism (N)	5278	1084	-.21***	5475	5403	5275	5202	4913
Intro-Extraversion (IE)	5369	1093	-.06 ns	5345	5353	5442	5471	5158
Conscientiousness (C)	4658	1053	.19***	4485	4559	4710	4721	4876
Openness (O)	5021	977	.05 ns	5083	4920	4978	4944	5300
Machiavellianism (M)	5143	958	-.01ns	5103	5250	5090	5154	5087

Notes. *** $p < .001$, * $p < .05$, r_{xy} is the uncorrected correlation with final school grade. Standard scores M=5000 SD=1000.

Figure 4.
SDI+ Domain Mean Scores by 17D Final School Grade Quintile



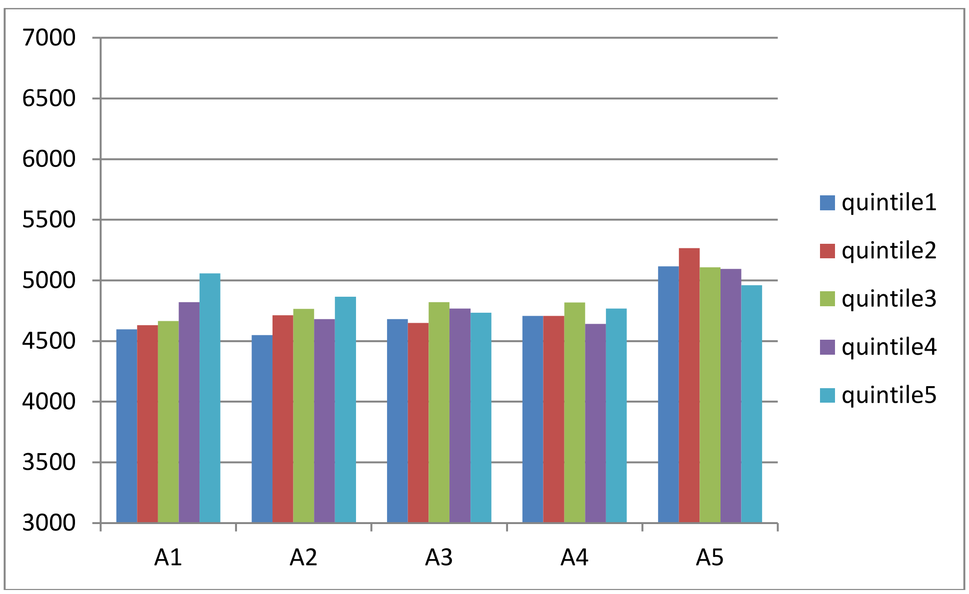
Note. Standard scores M=5000 SD=1000 on the y-axis.

Table 5.
SDI+ Agreeableness Facet Mean Scores by 17D Final School Grade Quintile

Agreeableness	M	SD	r_{xy}	quintile1	quintile2	quintile3	quintile4	quintile5
Team player (A1)	4728	978	.19***	4598	4631	4665	4820	5059
Pleasant (A2)	4715	1039	.11 ns	4549	4713	4766	4681	4866
Considerate (A3)	4732	1054	.08 ns	4680	4650	4820	4767	4733
Helpful-Altruistic (A4)	4732	997	.07 ns	4707	4708	4819	4642	4768
Hyper-Competitive (A5)	5125	1068	-.12*	5117	5267	5108	5094	4960

Notes. *** $p < .001$, * $p < .05$, r_{xy} is the uncorrected correlation with final school grade. Standard scores M=5000 SD=1000.

Figure 5.
SDI+ Agreeableness Facet Mean Scores by 17D Final School Grade Quintile



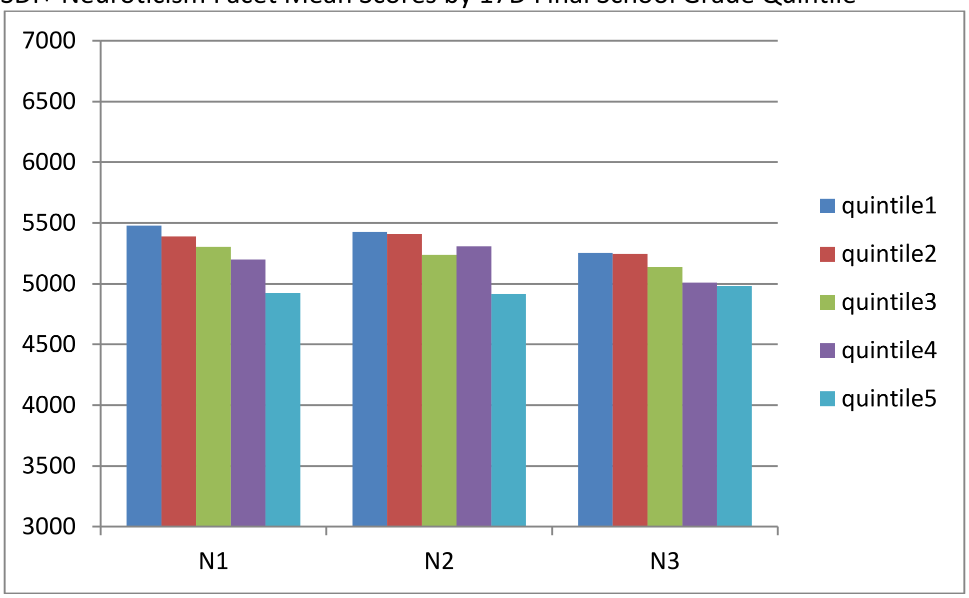
Note. Standard scores M=5000 SD=1000 on the y-axis.

Table 6.
SDI+ Neuroticism Facet Mean Scores by 17D Final School Grade Quintile

Neuroticism	M	SD	r_{xy}	quintile1	quintile2	quintile3	quintile4	quintile5
Stress-Under-Pressure (N1)	5284	1083	-.22***	5480	5390	5304	5200	4922
Temperamental (N2)	5282	1062	-.17**	5426	5407	5239	5309	4917
Worry (N3)	5140	1067	-.13*	5254	5247	5136	5009	4982

Notes. *** $p < .001$, ** $p < .01$, * $p < .05$, r_{xy} is the uncorrected correlation with final school grade. Standard scores M=5000 SD=1000.

Figure 6.
SDI+ Neuroticism Facet Mean Scores by 17D Final School Grade Quintile



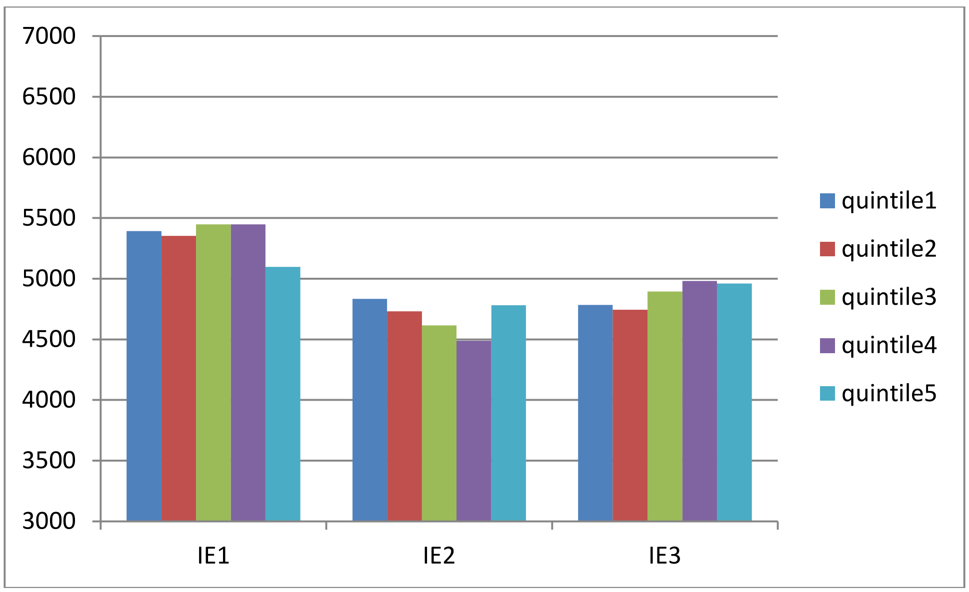
Note. Standard scores M=5000 SD=1000 on the y-axis.

Table 7.
SDI+ Intro-Extraversion Facet Mean Scores by 17D Final School Grade Quintile

Intro-Extraversion	M	SD	r_{xy}	quintile1	quintile2	quintile3	quintile4	quintile5
Unassertive (IE1)	5366	1112	-.09 ns	5392	5353	5448	5448	5098
Sociable (IE2)	4682	1056	-.03 ns	4833	4730	4615	4489	4781
Dominance (IE3)	4863	954	.13*	4783	4744	4894	4982	4961

Notes. * $p < .05$, r_{xy} is the uncorrected correlation with final school grade. Standard scores M=5000 SD=1000.

Figure 7.
SDI+ Intro-Extraversion Facet Mean Scores by 17D Final School Grade Quintile



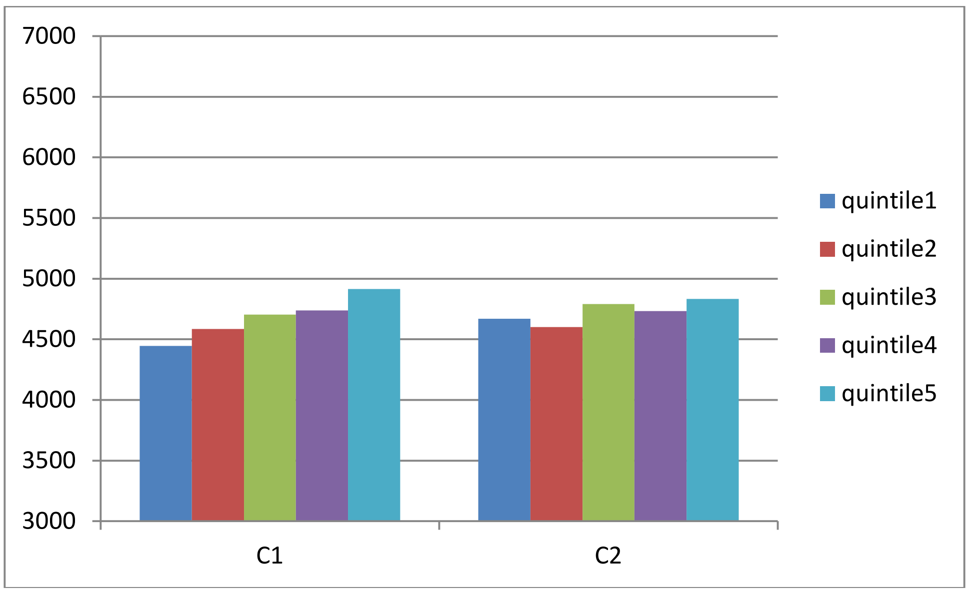
Note. Standard scores M=5000 SD=1000 on the y-axis.

Table 8.
SDI+ Conscientiousness Facet Mean Scores by 17D Final School Grade Quintile

Conscientiousness	M	SD	r_{xy}	quintile1	quintile2	quintile3	quintile4	quintile5
Achievement-Striving (C1)	4664	1066	.21***	4446	4586	4704	4739	4914
Order (C2)	4718	1033	.10 ns	4670	4601	4790	4734	4833

Notes. *** p < .001, r_{xy} is the uncorrected correlation with final school grade. Standard scores M=5000 SD=1000.

Figure 8.
SDI+ Conscientiousness Facet Mean Scores by 17D Final School Grade Quintile



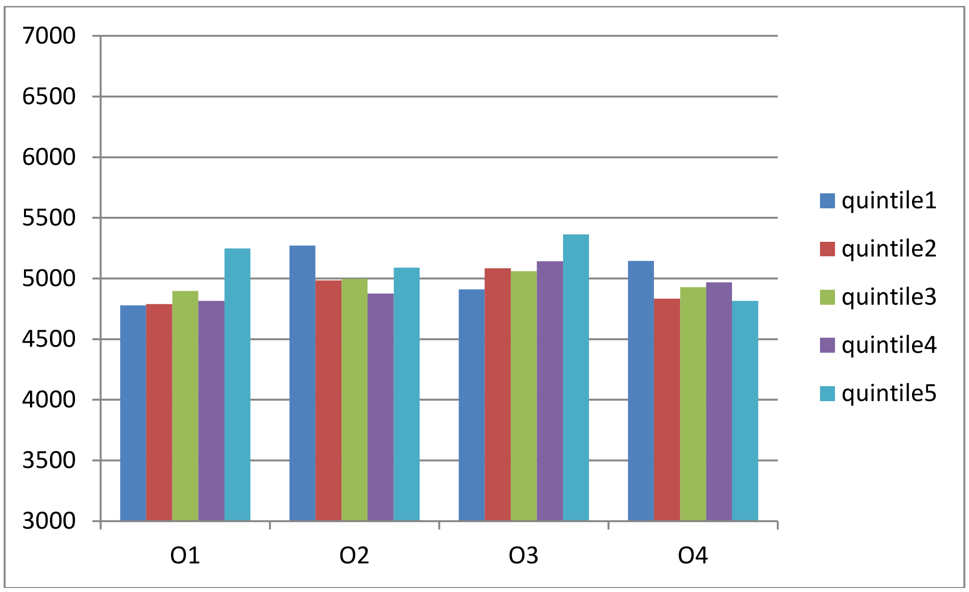
Note. Standard scores M=5000 SD=1000 on the y-axis.

Table 9.
SDI+ Openness Facet Mean Scores by 17D Final School Grade Quintile

Openness	M	SD	r_{xy}	quintile1	quintile2	quintile3	quintile4	quintile5
Creative (O1)	4884	989	.16**	4778	4789	4898	4815	5249
Reflective (O2)	5034	1018	-.06 ns	5271	4984	4998	4876	5090
Scientific Interest (O3)	5096	1001	.10 ns	4911	5084	5060	5142	5363
Cultured (O4)	4937	976	-.10 ns	5145	4834	4930	4969	4816

Notes. ** $p < .01$, r_{xy} is the uncorrected correlation with final school grade. Standard scores M=5000 SD=1000.

Figure 9.
SDI+ Openness Facet Mean Scores by 17D Final School Grade Quintile



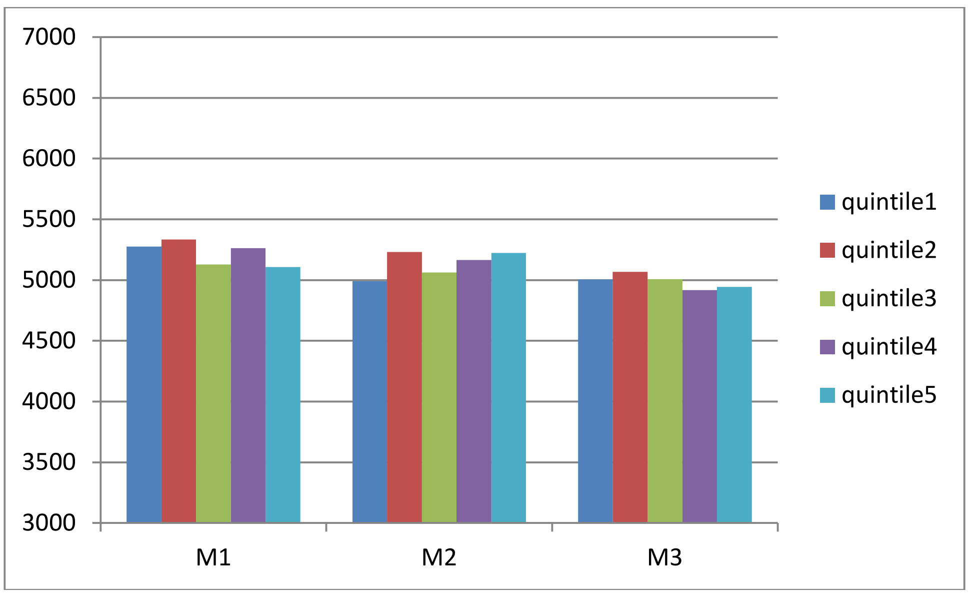
Note. Standard scores M=5000 SD=1000 on the y-axis.

Table 10.
SDI+ Mach Facet Mean Scores by 17D Final School Grade Quintile

Machiavellianism	M	SD	r_{xy}	quintile1	quintile2	quintile3	quintile4	quintile5
Envious (M1)	5227	982	-.06 ns	5277	5335	5128	5261	5107
Individualistic (M2)	5132	973	.04 ns	4991	5230	5063	5164	5224
Self-Serving (M3)	4996	939	.00 ns	5005	5068	5006	4916	4943

Notes. r_{xy} is the uncorrected correlation with final school grade. Standard scores M=5000 SD=1000.

Figure 10.
SDI+ Mach Facet Mean Scores by 17D Final School Grade Quintile



Note. Standard scores M=5000 SD=1000 on the y-axis.

Table 11.

Initial Cyber Composite Score.

Parameter/Model	*b*	*β*	*t/F*	*p*	*R/R²*
Intercept	70.77	0	24.58	<.0001	
Word Knowledge (WK)	0.24	.19	3.06	.0025	
General Science (GS)	0.37	.19	2.96	.0025	
Instrument Comprehension (IC)	0.17	.13	2.31	.0033	
Achievement Striving (C1)	0.0013	.21	3.85	.0218	
Sociable (IE2)	-0.0015	-.25	-2.12	.0001	
Sociable² (IE2²)	1.94^{-7}	.26	2.17	.0350	
Full Model			14.24	<.0001	.48/.23

Notes. N=295. *b* = unstandardized parameter estimate, *β* = standardized beta weight, *t* = parameter statistic, *F* = model statistic, *R* = multiple correlation, R^2 = coefficient of determination.

Table 12.

Final Cyber Composite Score (CCS) N=. CSS = WK + GS + IC + C1

Parameter/Model	*b*	*β*	*t/F*	*p*	*R*
Intercept	69.63	0	44.24	<.001	
Word Knowledge (WK)	0.25	0.19	4.17	<.001	
General Science (GS)	0.33	0.18	3.84	<.001	
Instrument Comprehension (IC)	0.13	0.10	2.40	<.05	
Achievement Striving (C1)	0.0013	0.21	5.52	<.001	
Full Model			31.6	<.001	.423

Notes. N=586. *b* = unstandardized parameter estimate, *β* = standardized beta weight, *t* = parameter statistic, *F* = model statistic, *R* = multiple correlation, N=586.

Table 13.

Final CCS Model Fit Comparisons for Six Cut-Scores

CCS Model	FSG_{hat} = WK + GS + IC + C1						
Cut-score	80*	81	82	83**	84	85	86
χ^2	114.00	94.15	37.53	78.91	42.80	24.80	25.19
Φ	.44	.40	.25	.37	.27	.21	.21
Total Power	98.63	98.46	97.10	94.53	90.10	84.30	74.92
Total Error	1.36	1.53	2.90	5.46	9.90	15.70	25.09

Notes. N=586, *Best fitting CSS cut-score for increasing accession pool. **Best fitting CSS cut-score for reducing attrition.

Table 14a.
Hit & Miss Rates for Final CCS Model Predicting FSG – Cut-Score 80

	At or Above Base rate 70	Incorrect Reject (Type II Error) n=2 0.34%	Correct Accept (α power) n=575 98.12%
Actual Final School Grade (FSG)	Below Base rate 70	Correct Reject (β power) n=3 0.51%	Incorrect Accept (Type I Error) n=6 1.02%
	N=586	Below Cut 80	At or Above Cut 80
		Cyber Composite Score (Predicted FSG)	

NOTE: Only data from those with a FSG shown here (made it through school).

Table 14b.
Hit & Miss Rates for Final CCS Model Predicting FSG – Cut-Score 83

	At or Above Base rate 70	Incorrect Reject (Type II Error) n=30 5.12%	Correct Accept (α power) n=547 93.34%
Actual Final School Grade (FSG)	Below Base rate 70	Correct Reject (β power) n=7 1.19%	Incorrect Accept (Type I Error) n=2 0.34%
	N=586	Below Cut 83	At or Above Cut 83
		Cyber Composite Score (Predicted FSG)	

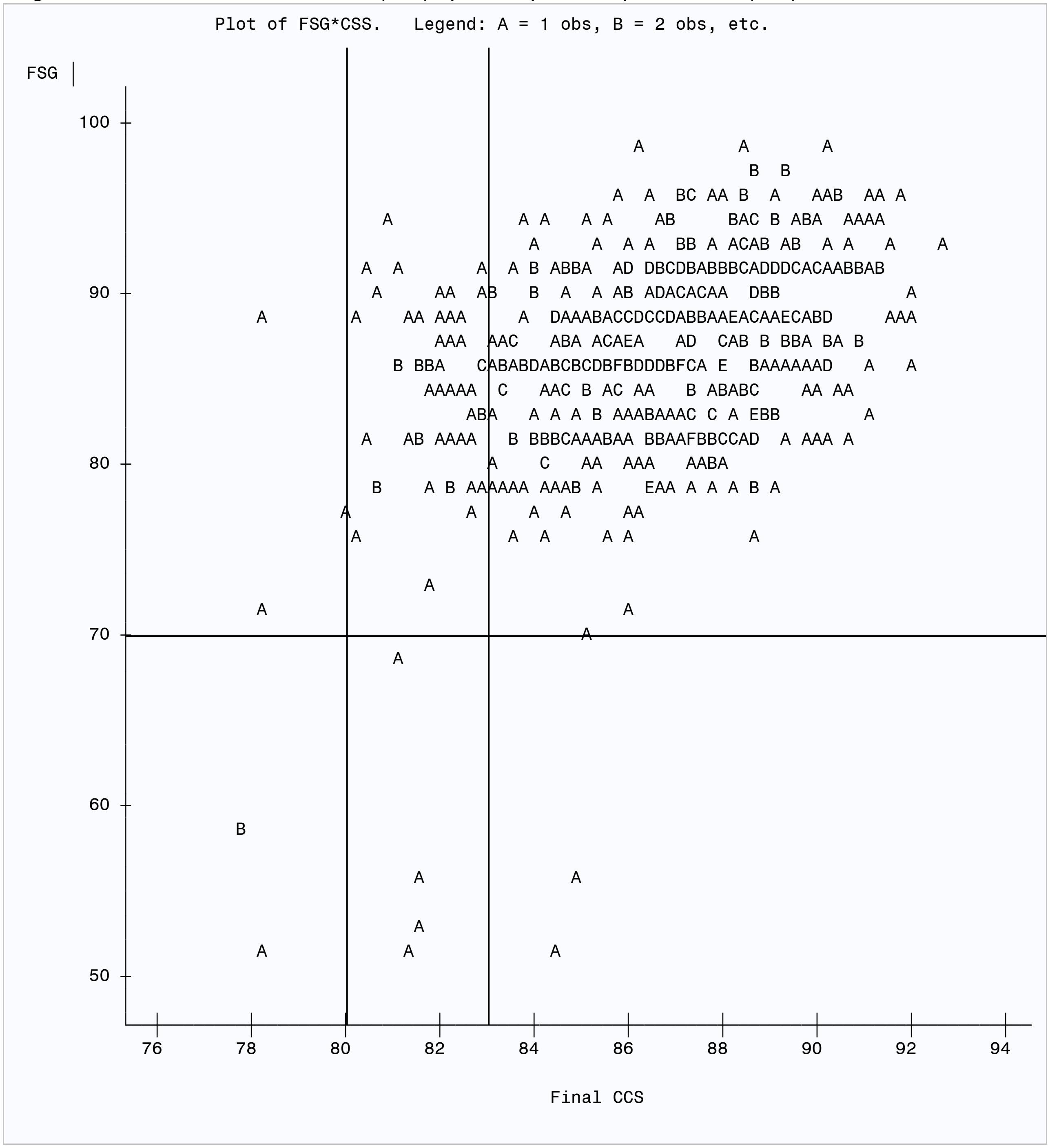
NOTE: Only data from those with a FSG shown here (made it through school).

Table 15.
Standardized Mean Score Differences (Cohen's *d*) on the Predictor Model (Cyber Composite Score).

Comparison	M_{maj}	SD_{maj}	N_{maj}	M_{min}	SD_{min}	N_{min}	*d*	95% CI_{low}	95% CI_{high}
Male-Female	86.94	2.55	960	85.24	2.52	180	0.67*	0.51	1.04
NonHispanic-Hispanic	86.69	2.63	1000	86.25	2.26	97	0.17*	0.01	0.62
White-Black	87.12	2.50	805	84.50	2.74	93	1.04*	0.87	1.60
White-Asian	87.12	2.50	805	86.26	2.45	109	0.34*	0.17	0.81

Notes. Ns=1097-898. Subscript maj = majority group, min = minority group; **p* < .05.

Figure 11. Plot of Final School Grade (FSG) by Final Cyber Composite Score (CCS)



Notes: N=586. Only data from those with a FSG shown here (i.e., those making it through school). C17DXL is var name for Final CCS in the AFPC/DSYX database (AFOQT Historical Masterfile), expressed in predicted FSG metric